December 1, 1998 F/AKC2:MG

PRELIMINARY CRUISE RESULTS
NOAA Ship *Miller Freeman*
Cruise No. 98-03

ECHO INTEGRATION-TRAWL SURVEY OF WALLEYE POLLOCK IN SHELIKOF STRAIT

CRUISE PERIOD, AREA, AND SCHEDULE

Scientists from the Alaska Fisheries Science Center (AFSC) conducted an echo integration-trawl (EIT) survey of walleye pollock (*Theragra chalcogramma*) in the Shelikof Strait area in the Gulf of Alaska aboard the NOAA ship *Miller Freeman* from March 11-25, 1998, for a total of 15 sea days. The cruise began in Dutch Harbor, AK and ended in Kodiak, AK.

The itinerary for the *Miller Freeman* was as follows:

VESSEL ITINERARY

Mar 11-13	Embark scientists in Dutch Harbor and transit to Shelikof Strait.
Mar 13-24	EIT survey of Shelikof Strait area.
Mar 24-25	Conduct sphere calibration in Spidiron Bay; transit to Kodiak.
Mar 25	Disembark scientists; end of cruise.

OBJECTIVES

The primary objectives of the cruise were to:

1. collect echo integration data and midwater and bottom trawl data necessary to determine the distribution, abundance, and biological composition of walleye pollock in the area of

operations;

2. collect pollock target strength data using hull-mounted and lowered transducers for use in scaling echo integration data to estimates of absolute abundance; and,

3. collect acoustic data from an acoustic-buoy to determine the distribution, and behavioral response of walleye pollock to ship and trawl noise.

The secondary objectives of the cruise were to:

1. calibrate the 38-kHz and 120-kHz scientific acoustic systems using standard sphere techniques;

2. collect physical oceanographic data including temperature and salinity profiles at selected sites, and conduct continuous monitoring of sea surface parameters (e.g., temperature, salinity, and light level);

3. spawn mature pollock and culture the fertilized eggs for laboratory experiments on eggs and larvae;

4. collect samples of pollock ovary tissue for studying the interannual variation in fecundity;

5. collect whole pollock and rockfish for the AFSC Observer Program;

6. collect Steller sea lion (*Eumetopias jubatus*) and northern fur seal (*Callorhinus ursinus*) prey items;

7. collect genetic samples of pollock for stock identification studies; and,

8. collect eulachon (*Thaleichthys pacificus*) for a seabird foraging study.

VESSEL, ACOUSTIC EQUIPMENT, AND TRAWL GEAR

The survey was conducted on board the NOAA ship *Miller Freeman*, a 66 m stern trawler equipped for fisheries and oceanographic research. Acoustic data were collected with a Simrad[1] EK500 quantitative echo-sounding system. Simrad 38 kHz and 120 kHz

[1]Reference to trade names or commercial firms does not constitute U.S. government endorsement.

split-beam transducers were mounted on the bottom of the vessel's retractable centerboard. The centerboard was fully extended during all scientific operations. This positioned the transducers 9 m below the surface. All results presented here are based on data collected with the 38 kHz transducer. Data from the Simrad EK500 echo sounder/receiver were processed using Simrad BI500 echo integration and target strength data analysis software on a SUN workstation.

Midwater echo sign was sampled with an Aleutian Wing 30/26 trawl (AWT), which is a full mesh wing trawl constructed of nylon except for polyethylene towards the aft section of the body and the codend. The headrope and footrope both measured 81.7 m (268 ft). Mesh sizes tapered from 3.25 m (128 in) in the forward section of the net to 89 mm (3.5 in) in the codend. The codend was fitted with a 32 mm (1.25 in) liner. The AWT was fished with 82.3 m (270 ft) of 1.9 cm (0.75 in) diameter 8x19 non-rotational dandylines, 340 kg (750 lb.) tom weights on each side, and 5 m^2 (53.8 ft^2) “Fishbuster doors” (1,250 kg [2,750 lb.]).

Fish on and near bottom were sampled with a polyethylene Nor'eastern high-opening bottom trawl equipped with roller gear. The trawl was constructed with stretch mesh sizes that ranged from 13 cm (5 in) in the forward portion of the net to 89 mm (3.5 in) in the codend. It was fitted with a nylon codend liner with a mesh size of 32 mm (1.25 in). The 27.2 m (89.1 ft) headrope held 21 floats [30 cm (12 in) diameter]. A 24.7 m (81 ft) chain fishing line was attached to the 24.9 m (81.6 ft) footrope which was constructed of 1 cm (0.4 in) 6 x 19 wire rope wrapped with polypropylene rope. The 24.2 m (79.5 ft) roller gear was constructed with 36 cm (14 in) rubber bobbins spaced 1.52.1 m (5-7 ft) apart. A solid string of 10 cm (4 in) rubber disks separated some of the bobbins in the center section of the roller gear. Two 5.9 m (19.5 ft) wire rope extensions with 10 cm (4 in) and 20 cm (8 in) rubber disks were used to span the two lower flying wing sections and were attached to the roller gear. The roller gear was attached to the fishing line using chain toggles [2.9 kg (6.5 lb.) each] which were comprised of five links and one ring. The trawl was rigged with triple 54.9 m (180 ft) galvanized wire rope dandylines. The net was fished with the “Fishbuster” doors.

Most trawl hauls were monitored with a WesMar third wire trawl sonar attached to the headrope of the trawl. Vertical and horizontal net openings, depth, and temperature at depth were measured.

Vertical profile measurements of water temperature and salinity were collected at calibration sites using a Seabird CTD (conductivity/temperature/depth) system. Temperature profile data were also collected by attaching micro bathythermographs

(MBT) to the trawl headropes.

The acoustic buoy consists of an aluminum cylinder (length 130 cm) with a “donut” Ionomer foam floatation collar and mast at one end. A bulkhead inside the cylinder separates the cylinder into an upper (i.e., instrument) and lower (i.e., battery) watertight compartment which can be accessed by removing the appropriate aluminum end cap. The acoustic-buoy electronic components include a Simrad EY500 echosounder operating at 38 kHz, communications hardware and other instrumentation. Data are stored onboard the buoy and telemetered directly to the support vessel. A UHF radio link between the buoy and vessel is used to control the echosounder, receive buoy positions based on GPS, and remotely generate echograms in real-time. The GPS data from the buoy are also transmitted via the Argos satellite system to the vessel to locate the buoy in the event that visual, radar, and direct radio contact are lost. A split-beam transducer and heading sensor are suspended 6.5 m below the buoy. Transducer heading data from the buoy are collected and used in analyses to assess the directivity of the fish response (i.e., movement relative to vessel and trawl). Four 100 ampere-hour gel cell batteries power the buoy; one battery powers the GPS/Argos transceiver while three power the remaining instruments. The total weight of the buoy is about 300 kg.

SURVEY METHODS

One survey pass was conducted in the Shelikof Strait area to assess the distribution, abundance, and biological characteristics of pollock. The "Shelikof Strait area" refers to Shelikof Strait and the area surveyed between Middle Cape and Chirikof Island. Survey transects were oriented parallel to one another. Transects were spaced 14 km (7.5 nmi) apart except on the western side of the Strait, where 7 km (3.75 nmi) spacing was used (Fig. 1). Greater sampling effort was allocated to the western side of the Strait because it has historically contained most of the pollock spawning biomass. Transects generally did not extend into waters less than about 50 m in depth.

Survey operations were conducted 24 hours a day. Average vessel speed was 11 knots when running transects. Echo integration data were collected with a horizontal resolution of about 9 m and a vertical resolution of 0.5 1 m. The acoustic system was used to collect echo-integration and *in situ* target-strength data during survey operations. Estimates of absolute pollock abundance will be derived from the former data after they are appropriately scaled.

Midwater and bottom trawl hauls were made at selected locations

to identify echosign and provide biological samples. Average trawling speed was about 3 knots. The vertical net opening for the midwater AWT trawl averaged about 24 m (range 21-31 m). The PNE trawl vertical mouth opening was about 6 m (range 5-9 m).

Standard catch sorting and biological sampling procedures were used to provide weight and number by species for each haul. Pollock were further sampled to determine sex, fork length (FL), age, maturity (8-point scale), and body and ovary weights. An electronic scale was used to determine weights of individual pollock specimens. Fish lengths were usually taken with a polycorder measuring device (a combination of a bar code reader and a hand held computer). Tissue and otolith samples were collected from individual walleye pollock for AFSC Fisheries-Oceanography Coordinated Investigations and Alaska Department of Fish and Game genetic research. Fecundity samples were removed from mature females and preserved in 10% formalin. Adult pollock were successfully spawned, and the fertilized eggs were transported to Seattle, WA, and Newport, OR, where various studies utilizing pollock eggs and larvae are conducted.

Pollock target strength data was collected on an opportunistic basis. Certain conditions (i.e., low fish densities, single species, and unimodal size composition) were required for this work to be successful. Collection of target strength data involved repeated passes over an aggregation of fish at a vessel speed of approximately 3-5 knots. A second method of collecting target strength data was conducted with the vessel stopped and a 38-kHz transducer lowered to a depth just above the fish sign for data collection using a lowered-transducer winch assembly.

The primary objective of the acoustic buoy was to determine if a change occurred in the total water column area back scattering coefficient (S_A) as a result of vessel noise generated while conducting a series of free-running passes at normal survey vessel speed (i.e., 12 knots). The vessel traveled at least 2 km from the buoy, then steamed toward the buoy, passing as closely as possible, and continued on until the buoy was at least 2 km away.

PRELIMINARY RESULTS

Four standard sphere calibrations were carried out in conjunction with the survey (Table 1). Three calibrations were completed prior to the cruise: on February 5 in Puget Sound, WA; on March 2 in Nateekin Bay, Unalaska Island, AK; and on March 10 in Captain’s Bay, Unalaska Island, AK. Upon completion of the EIT survey a calibration was conducted on March 24 in Spidiron Bay,

Kodiak Is., Alaska. No significant differences in the 38 kHz

system parameters were observed among the four calibrations.

Acoustic data were collected between March 13-24 in the Shelikof Strait area along about 1,700 km (900 nmi) of transect tracklines (Fig. 1). Acoustic backscattering was assigned to 3 categories of echosign: well-defined midwater layers of either primarily age-4 pollock or age-1 pollock about 150-200 m below the surface or near-bottom layers of primarily adult and subadult pollock. The densest aggregations of near-bottom acoustic backscattering were distributed off of Cape Kuliak along the west side of the Strait (Fig. 2). The echosign was less dense but extended farther along transect lines off of Cape Kekurnoi and in the southern portion of the survey area. Most of the echosign was detected within 50-100 m of the bottom. The highest densities of acoustic backscattering attributed primarily to pollock from the 1994 year class (year class is tentatively identified on the basis of fork length because otolith age data are not yet available) was observed between Cape Kekurnoi and Middle Cape and between Uyak Bay and Middle Cape on the Kodiak Island side of the Strait (Fig. 3). Acoustic backscattering attributed to midwater layers of the 1997 year class occurred only on the eastern ends of the southernmost transects (Fig. 4).

Biological data were collected at 22 AWT midwater and 9 PNE bottom trawl locations (Tables 2-3, Fig. 1). The size composition of pollock varied in different regions of the survey area (Fig. 5). The numbers of age-1 pollock (modal FL 12 cm) exceeded the catch of other pollock in tows that targeted the age-1 mid-water layer, although hauls 9 and 12 also contained significant amount of age-2 and age-4 pollock. The numbers of age-4 pollock (modal FL 33 cm) greatly exceeded the catch of other pollock in all of the tows that targeted the age-4 layer. Near-bottom tows conducted in the southern Strait area caught a mixture of age-1 (modal FL 13 cm), age-4 (modal FL 35 cm) and adult pollock (modal FL 53 cm), with a lesser amount of age-2 pollock (modal FL 23 cm). Tows made between Capes Kekurnoi and Kuliak on the western side of the Strait caught mostly adult pollock (modal FL 54 cm).

Pollock was the dominant fish species captured in midwater trawl hauls, comprising 96.3% by weight and 87.1% by numbers of the total catch (Table 4). Eulachon was the next most common species caught (12.7% by number) and were primarily associated with tows targeting near bottom echosign south of Katmai Bay. Pollock ranked first in weight and numbers among fishes captured in bottom trawl hauls, comprising 75.6% and 71.3% respectively (Table 5). Arrowtooth flounder (*Atheresthes stomias*, 14.3% by weight) and eulachon (9.4% by numbers) were the next most common species caught. Table 6 summarizes the special studies carried

out during the survey.

A total of 2,620 pollock were sampled for maturity from the trawl catches during the survey. No females less than 31 cm FL or males less than 33 cm FL were classified as mature (Fig. 6). Fifty-three percent of the females greater than 34 cm FL were either in prespawning or spawning condition and only 8.1% were in spent condition. The mean gonadosomatic index, defined as the ratio of gonad weight to total body weight for mature females, was 0.17 (Fig. 7).

Pollock target strength data was collected on six occasions. Target strength data was collected once using only the hull-mounted transducer. The lowered tranducer assembly was deployed 4 times at night (twice on March 16 and once on March 21 and 23) and once during daylight (on March 23). Six hauls were conducted in association with the target strength work (Table 2). Preliminary results show a bias against smaller targets at greater ranges from the tranducer. Analysis of the target strength is in progress.

The acoustic buoy was deployed 4 times during the survey. Thirty-six free-running passes were conducted over either near-bottom pre-spawning adult pollock or midwater layers of primarily age-4 pollock. Two bottom trawl hauls (with the codend open) targeted near-bottom pre-spawners during the second buoy deployment to determine the fish reaction to the trawl/vessel combination. Performance of the buoy was excellent. Preliminary results suggested that the fish did not exhibit a dramatic response to vessel noise generated as the vessel passed the buoy, although on several passes, S_A estimates declined slightly as the vessel passed the buoy. However, a more thorough examination of the data is in progress to verify these initial observations.

SCIENTIFIC PERSONNEL

Name	Sex/ Nationality	Position	Organization	Dates aboard
Chris Wilson	M/USA	Chief Scientist	AFSC	Mar. 11-25
Jim Traynor	M/USA	Fish. Biologist	AFSC	Mar. 11-25
Michael Guttormsen	M/USA	Fish. Biologist	AFSC	Mar. 11-25
Taina Honkalehto	F/USA	Fish. Biologist	AFSC	Mar. 11-25
Steve de Blois	M/USA	Fish. Biologist	AFSC	Mar. 11-25
Kevin Landgraf	M/USA	Fish. Biologist	AFSC	Mar. 11-25
Keith Smith	M/USA	Fish. Biologist	AFSC	Mar. 11-25

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Table 1. Summary of sphere calibrations conducted before, during, and after the 1998 echo integration-trawl survey of the Shelikof Strait area.

Date (1998)	Location	Freq (kHz)	Water Temp (deg. C) at Transducer*	Water Temp (deg. C) at Sphere	Sphere Range from Transducer (m)	TS Gain (dB)	SV Gain (dB)	Along 3 dB Beam Width (deg.)	Angle Offset Along	Angle Offset Athwart
5 Feb	Port Susan, WA	38	9.4	10.0	28.3	27.2	27.2	6.73	0.01	-0.03
2 Mar	Nateekin Bay, AK	38	3.6	3.8	26.8	27.0	--	--	--	--
10 Mar	Captains Bay, AK	38	3.8	3.7	32.1	27.1	27.1	6.79	0.01	-0.03
24 Mar	Spidiron Bay, AK	38	5.3	5.4	34.4	27.1	27.1	--	--	--
Feb-Mar	System settings during surveys	38	--	--	--	27.1	27.1	6.70	-0.09	-0.02

* The transducer is located approximately 9 m below the water surface.

Note: Gain and beam pattern terms are defined in the "Operator Manual for Simrad EK500 Scientific Echo Sounder (1993)" available from Simrad Subsea A/S , Standpromenaden 50, P.O. Box 111 N-3191 Horten, Norway.

Table 2. Summary of trawl and catch data from the 1998 pollock echo integration-trawl survey of the

Haul No.	Gear[1] type	Date (GMT)	Time GMT)	Duration (minutes)	Start position Lat (N)	Long (W)	Depth (m) gear	bottom	Temp. (deg. C) gear	surface	MBT cast number	Pollock catch kg	number	Other catch kg	number
1	317	14 Mar	4:02	8	55 47.10	156 8.73	201	225	6.2	5.3	1	19.9	1,437	1.8	174
2[T]	317	14 Mar	11:19	20	55 56.15	156 13.47	67	214	5.7	5.3	2	4.3	127	1.9	21
3	172	14 Mar	18:44	30	56 11.71	156 9.21	247	247	5.5	5.3	3	146.3	989	1,015.9	671
4	317	14 Mar	23:17	21	56 18.77	156 8.75	193	252	5.5	5.2	4	152.1	5,939	8.9	6
5	317	15 Mar	5:19	15	56 27.09	156 10.06	258	271	5.4	5.1	5	2,005.2	4,153	92.8	581
6	317	15 Mar	15:05	8	56 41.42	155 59.68	276	302	5.4	5.4	6	3,107.9	4,949	52.1	60
7	317	16 Mar	0:41	5	56 56.19	155 56.37	258	291	5.4	5.5	7	2,382.6	4,612	805.4	9,853
8	317	16 Mar	2:30	7	56 55.43	155 49.66	186	303	5.1	5.5	8	4,100.0	14,034	0.0	0
9	317	16 Mar	7:37	25	56 46.98	155 24.63	189	230	--	5.3	9	204.0	1,222	15.1	387
10[T]	317	16 Mar	14:40	5	56 52.10	155 12.57	171	199	5.2	5.0	10	49.7	89	5.7	54
11[T]	317	16 Mar	16:22	10	56 52.30	155 12.97	162	200	5.1	5.1	11	17.7	34	0.9	24
12	317	17 Mar	20:09	30	56 55.97	155 14.94	184	229	5.6	5.4	12	81.9	659	0.6	19
13	317	18 Mar	0:50	6	57 12.75	155 13.21	202	239	4.9	5.3	13	1,174.1	5,102	2.5	38
14	317	18 Mar	10:52	19	57 28.13	155 4.38	212	236	5.6	5.4	14	1,403.8	3,617	398.2	6,230
15	172	18 Mar	20:16	15	57 31.80	155 12.34	253	253	5.1	5.4	15	1,483.1	1,269	671.1	969
16	317	18 Mar	23:31	10	57 32.48	155 13.21	185	260	5.6	5.5	16	4,691.4	17,203	8.6	129
17	317	19 Mar	7:27	13	57 40.23	154 46.45	130	222	5.7	4.7	17	1,894.4	7,040	5.6	16
18	317	19 Mar	12:04	8	57 41.65	155 2.65	184	265	5.6	4.8	18	1,896.5	6,532	3.5	45
19	317	19 Mar	19:14	15	57 42.26	155 14.72	253	292	5.1	3.8	19	5,094.2	9,416	105.8	280
20	172	20 Mar	5:14	15	57 47.90	154 46.92	247	247	5.1	5.3	20	1,741.7	1,508	648.3	1,037
21	317	20 Mar	9:39	3	57 42.28	154 25.78	81	207	--	4.8	21	6,240.0	21,415	0.0	0
22	317	20 Mar	16:00	12	57 58.94	154 22.96	272	289	6.1	5.4	22	5,603.6	8,555	71.4	299
23	172	21 Mar	3:57	5	58 0.59	154 15.39	252	252	6.3	5.7	23	1,745.2	1,838	212.6	127
24[T]	317	21 Mar	8:35	17	57 50.80	154 1.26	140	204	5.8	5.3	24	1,209.2	4,295	12.9	24
25	172	22 Mar	3:49	2	58 7.83	154 9.60	223	223	5.9	4.3	25	1,900.1	1,303	254.9	11
26	172	22 Mar	11:13	2	58 11.60	153 55.74	212	212	6.3	4.0	26	1,705.6	1,372	30.4	15
27	172	22 Mar	23:16	3	58 10.96	153 54.53	206	206	6.1	4.8	27	805.7	550	74.0	231
28[T]	317	23 Mar	15:05	35	58 7.99	154 5.21	207	282	6.1	3.8	28	841.8	672	7.8	51
29[T]	172	23 Mar	17:37	18	58 8.32	154 5.68	284	284	6.1	3.9	29	1,362.2	1,237	337.8	155
30	172	24 Mar	4:52	15	57 42.38	155 6.58	282	282	5.4	5.0	30	668.9	661	479.6	1,102
31[T]	317	24 Mar	13:16	14	57 42.10	154 46.02	145	226	6.1	5.3	31	1,003.7	3,719	59.2	265

[1]Gear type 172 = poly Nor'eastern bottom trawl, 317 = Aleutian wing trawl

[T]Target strength haul.

Table 3. Summary of pollock biological samples and measurements collected during the 1998 echo integration-trawl survey of the Shelikof Strait area.

Haul	Length	Maturity	Otoliths	Fish weight	Ovary weight
1	181	28	5	28	0
2	52	25	0	25	0
3	318	74	53	74	5
4	374	130	56	130	0
5	498	104	56	104	17
6	432	86	56	86	17
7	413	112	59	112	11
8	230	25	25	25	0
9	271	98	61	98	3
10	89	89	0	89	12
11	34	34	34	34	4
12	364	82	56	82	0
13	400	91	69	91	0
14	417	86	55	86	4
15	390	85	59	85	46
16	522	79	56	79	1
17	306	63	50	63	0
18	352	111	50	111	0
19	489	71	71	71	3
20	353	131	101	131	50
21	387	66	52	66	2
22	509	104	104	104	4
23	368	100	100	100	5
24	392	96	51	96	1
25	336	115	115	115	77
26	105	105	104	105	15
27	320	69	61	69	36
28	361	101	1	101	36
29	378	55	55	55	0
30	424	116	56	116	22
31	371	89	0	89	4
Total	10,436	2,620	1,671	2,620	375

Table 4. Summary of catch by species in Aleutian Wing midwater trawls conducted during the 1998 pollock echo integration-trawl survey of the

Common name	Scientific name	Weight (kg)	Percent	Numbers	Percent
Walleye pollock	*Theragra chalcogramma*	43,177.9	96.3%	124,821	87.1%
Eulachon	*Thaleichthys pacificus*	982.6	2.2%	18,197	12.7%
Pacific sleeper shark	*Somniosus pacificus*	390.3	0.9%	7	<0.1%
Arrowtooth flounder	*Atheresthes stomias*	99.5	0.2%	90	0.1%
Berryteuthis magister	*Berryteuthis magister*	56.9	0.1%	126	0.1%
Pacific cod	*Gadus macrocephalus*	52.1	0.1%	15	<0.1%
Chinook salmon	*Oncorhynchus tshawytsc*	28.5	0.1%	17	<0.1%
Pacific halibut	*Hippoglossus stenolepis*	22.8	0.1%	4	<0.1%
Smooth lumpsucker	*Aptocyclus ventricosus*	11.6	<0.1%	5	<0.1%
Flathead sole	*Hippoglossoides elassoc*	8.2	<0.1%	32	<0.1%
Jellyfish unidentified	Scyphozoa	6.8	<0.1%	3	<0.1%
Sablefish	*Anoplopoma fimbria*	1.1	<0.1%	6	<0.1%
Squid unidentified	Teuthoidea	0.1	<0.1%	5	<0.1%
Shrimp unidentified	Decapoda	0.1	<0.1%	29	<0.1%
Sidestripe shrimp	*Pandalopsis dispar*	0.1	<0.1%	9	<0.1%
Pacific herring	*Clupea pallasi*	<0.1	<0.1%	7	<0.1%
Slender barracudina		<0.1	<0.1%	1	<0.1%
Capelin	*Mallotus villosus*	<0.1	<0.1%	3	<0.1%
Total		44,838.7		143,377	

Table 5. Summary of catch by species in poly Nor'eastern trawls conducted during the 1998 pollock echo integration-trawl survey of the Shelikof Strait

Common name	Scientific name	Weight (kg)	Percent	Numbers	Percent
Walleye pollock	*Theragra chalcogramma*	11,558.9	75.6%	10,727	71.3%
Arrowtooth flounder	*Atheresthes stomias*	2,182.1	14.3%	1,404	9.3%
Big skate	*Raja binoculata*	563.9	3.7%	17	0.1%
Pacific halibut	*Hippoglossus stenolepis*	255.7	1.7%	36	0.2%
Pacific sleeper shark	*Somniosus pacificus*	150.0	1.0%	1	<0.1%
Eulachon	*Thaleichthys pacificus*	127.3	0.8%	1,420	9.4%
Skate unidentified	Rajidae unident.	82.7	0.5%	4	<0.1%
Longnose skate	*Raja rhina*	82.1	0.5%	9	0.1%
Flathead sole	*Hippoglossoides elassod*	47.2	0.3%	106	0.7%
Pacific cod	*Gadus macrocephalus*	39.0	0.3%	14	0.1%
Berryteuthis magister	*Berryteuthis magister*	32.1	0.2%	45	0.3%
Sea cucumber unidentifi	Holothuroidea	27.2	0.2%	368	2.4%
Bering skate	*Bathyraja interrupta*	26.3	0.2%	15	0.1%
Rougheye rockfish	*Sebastes aleutianus*	17.6	0.1%	19	0.1%
Bigmouth sculpin	*Hemitripterus bolini*	16.3	0.1%	5	<0.1%
Dover sole	*Microstomus pacificus*	13.4	0.1%	17	0.1%
Giant wrymouth	*Cryptacanthodes gigant*	10.7	0.1%	2	<0.1%
Squid unidentified	Teuthoidea	9.3	0.1%	12	0.1%
Sidestripe shrimp	*Pandalopsis dispar*	6.4	<0.1%	515	3.4%
Chionoecetes bairdi	*Chionoecetes bairdi*	6.1	<0.1%	14	0.1%
Rex sole	*Glyptocephalus zachirus*	5.8	<0.1%	6	<0.1%
Jellyfish unidentified	Scyphozoa	3.4	<0.1%	0	<0.1%
Sablefish	*Anoplopoma fimbria*	3.4	<0.1%	14	0.1%
Smooth lumpsucker	*Aptocyclus ventricosus*	2.9	<0.1%	2	<0.1%
Chionoecetes bairdi	*Chionoecetes bairdi*	2.0	<0.1%	3	<0.1%
Snail unidentified	Gastropod unident.	2.0	<0.1%	30	0.2%
Starry flounder	*Platichthys stellatus*	1.6	<0.1%	1	<0.1%
Pandalus borealis	*Pandalus borealis*	1.1	<0.1%	158	1.1%
Wattled eelpout	*Lycodes palearis*	1.1	<0.1%	5	<0.1%
Sea anemone unidentifie	Actiniaria	1.0	<0.1%	9	0.1%
Longfin eelpout	*Bothrocara remigerum*	0.9	<0.1%	3	<0.1%
Longsnout prickleback	*Lumpenella longirostris*	0.8	<0.1%	7	<0.1%
Golden king crab	*Lithodes aequispina*	0.7	<0.1%	1	<0.1%
Prickleback unidentified	*Sebastes aleutianus*	0.7	<0.1%	6	<0.1%
Hermit crab unidentified	Paguridae	0.7	<0.1%	12	0.1%
Spinyhead sculpin	*Dasycottus setiger*	0.2	<0.1%	7	<0.1%
Neptunea sp.	Neptunea sp.	0.2	<0.1%	1	<0.1%
Shortfin eelpout	*Lycodes brevipes*	0.2	<0.1%	6	<0.1%
Basketstarfish unidentifi	Basketstarfish unidentifi	0.2	<0.1%	1	<0.1%
Pribilof whelk	*Neptunea pribiloffensis*	0.1	<0.1%	9	0.1%
Oregon triton	*Fusitriton oregonensis*	0.1	<0.1%	1	<0.1%
Ctenodiscus sp.	Ctenodiscus sp.	0.1	<0.1%	12	0.1%
Snailfish unidentified	Cyclopteridae	<0.1	<0.1%	1	<0.1%
Total		15,283.4		15,045	

Table 6. Summary of biological samples collected for special projects during the 1998 pollock echo integration-trawl survey of the Shelikof

Haul	Pollock Spawning (M/F)	Observ.Pro Samples POL/RF	Pollock Ovary Collection	Pollock Genetics #1[1]	Genetics #2[2]	NMML Steller S.L Prey Items	NMML N. Fur Sea Prey Items[3]	Age-1 Collection[3]
1	-	-	-	-	-	Poll , Cap	SQ, Sal	Y
2	-	-	-	-	-	-	Sal	Y
3	-	RE, PC	2	-	-	-	SQ	Y
4	-	Sal	-	-	-	-	-	Y
5	-	-	-	-	-	SQ	SQ	Y
6	-	-	8	-	-	-	-	-
7	-	-	2	-	-	-	-	-
8	-	-	-	-	-	-	-	-
9	-	Sal	-	-	-	-	Sal	Y
10	-	-	-	-	-	SQ	-	-
11	-	-	2	-	-	-	-	-
12	-	Sal	-	-	-	Sal	-	Y
13	-	-	-	-	-	-	Sal	-
14	-	PC	1	-	-	-	-	Y
15	-	-	5	-	-	SQ	SQ	-
16	-	Sal	1	-	-	Sal	-	-
17	-	-	-	-	-	-	-	-
18	-	-	-	-	-	Sal	-	-
19	-	Sal	2	-	20	-	-	-
20	-	-	3	-	20	Poll, SQ	Poll	-
21	-	-	2	-	-	Poll	Poll	-
22	-	-	-	-	20	SQ	-	-
23	-	-	-	-	20	-	Poll	-
24	-	-	1	-	-	-	Sal	-
25	-	-	3	91	20	-	-	-
26	(3/4)	-	-	-	-	-	-	-
27	-	-	-	-	-	SQ	-	-
28								
29								
30								
31								
Total	8,000 egg	Completed	46	91	100	Completed	Completed	>100 kg

[1] #1-Fin clips only
[2] #2-Muscle, Heart and liver
[3] Pigeon Guillemot (*Cepphus columba*) prey item.

Y - collection made

Sal-Salmon, SQ-Squid, Poll-Pollock, Cap-Capelin, RE-Rougheye rockfish, PC- Pacific cod

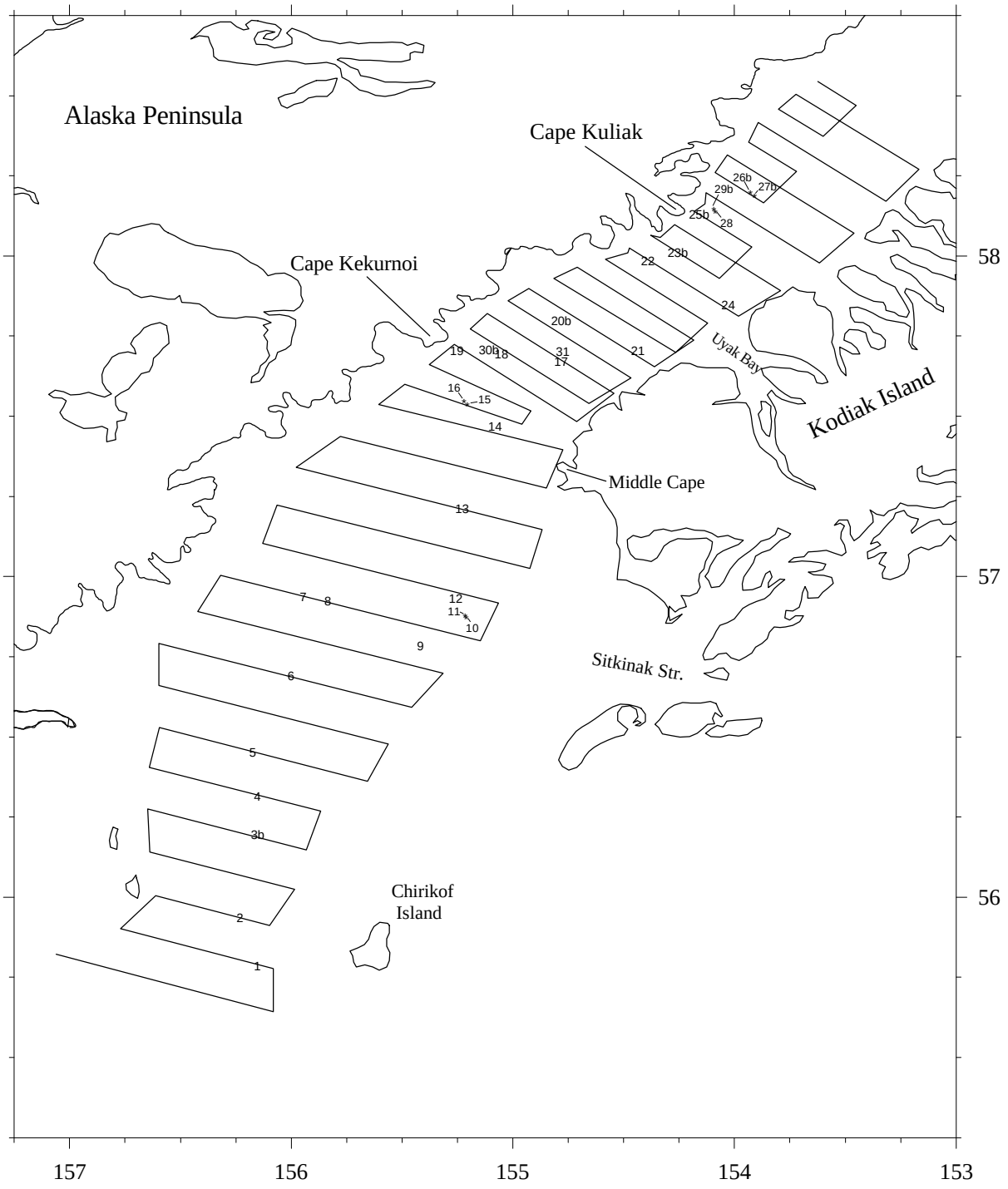

Figure 1. Survey trackline and locations of hauls conducted during the 1998 echo integration-trawl survey of the Shelikof Strait area. Numbers represent hauls made with the Aleutian wing trawl. Numbers followed by "b" represent hauls made with the poly nor'eastern bottom trawl.

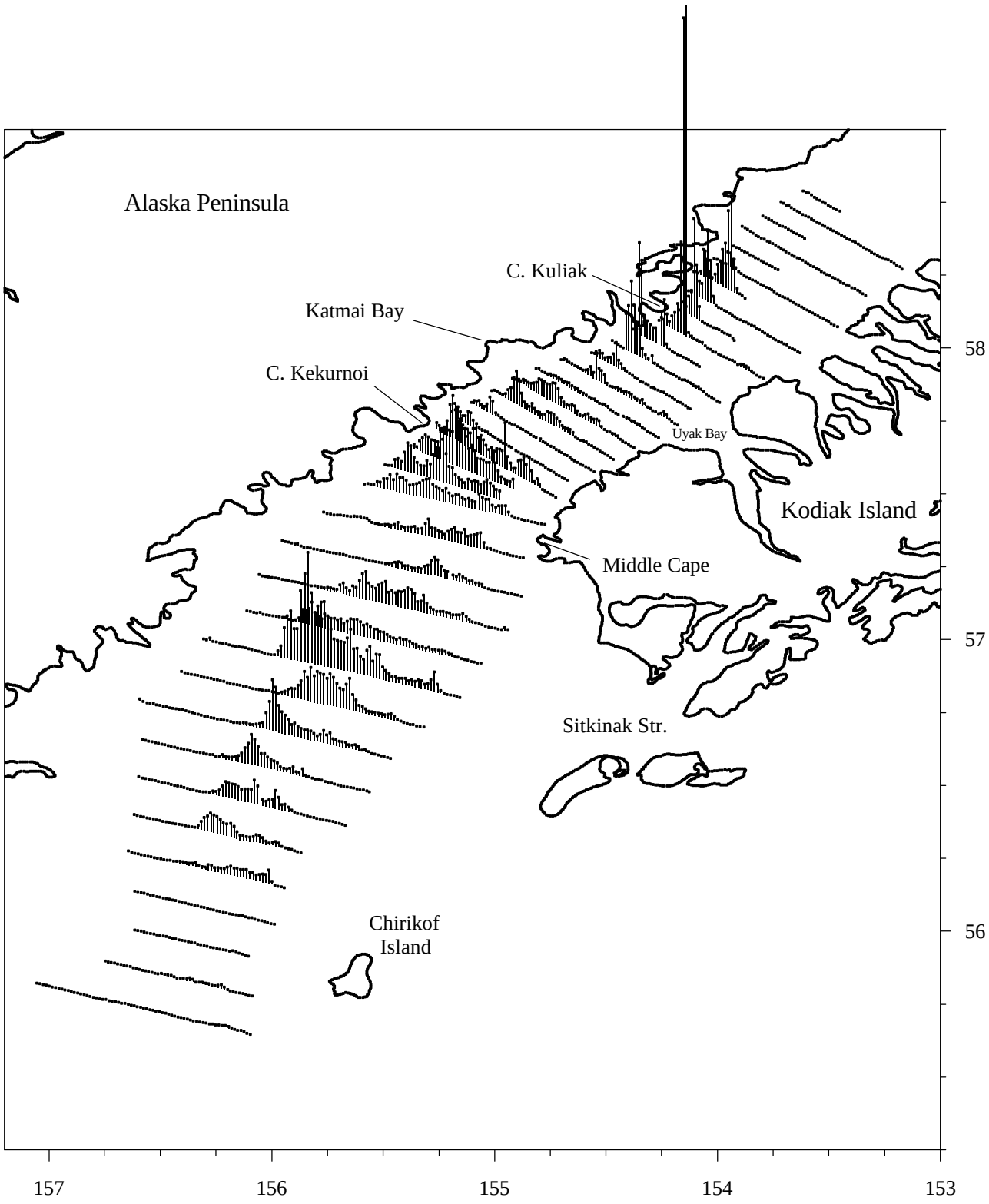

Figure 2. Acoustic backscattering (S_A) attributed to near-bottom pollock along tracklines during the 1998 echo integration-trawl survey of the Shelikof Strait area.

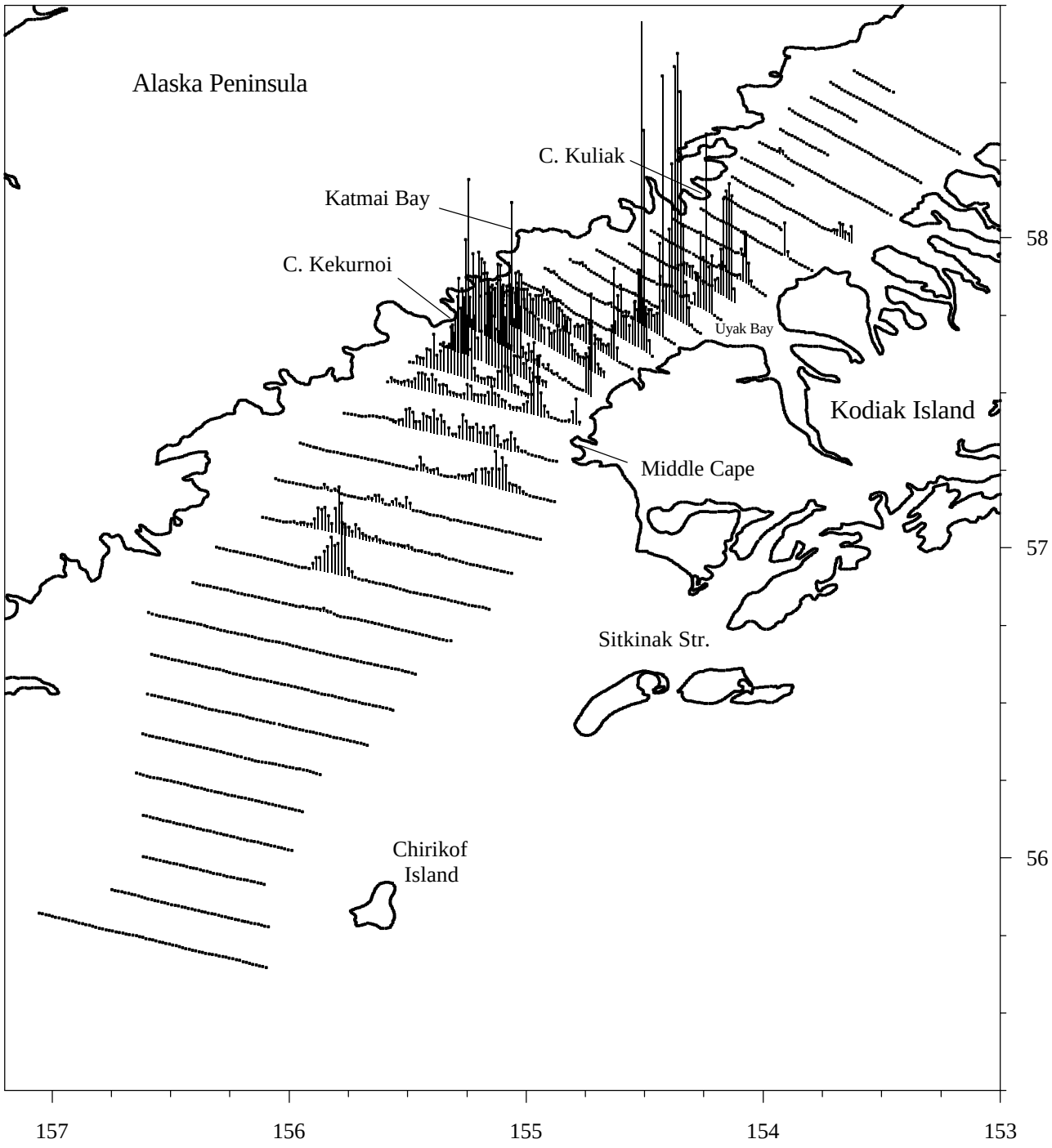

Figure 3. Acoustic backscattering (S_A) attributed primarily to age-4 pollock along tracklines during the 1998 echo integration-trawl survey of the Shelikof Strait area.

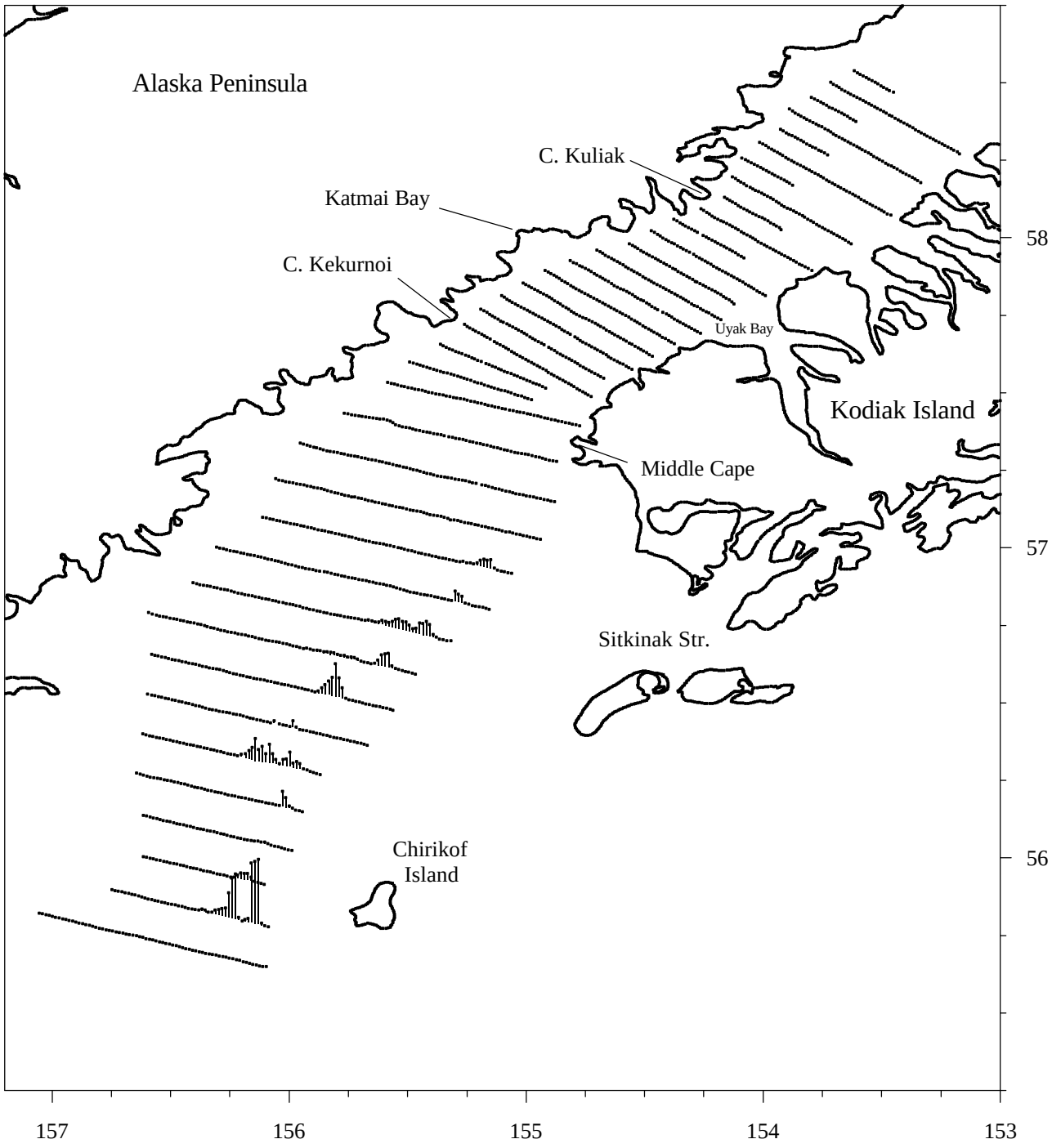

Figure 4. Acoustic backscattering (S_A) attributed primarily to age-1 pollock along tracklines during the 1998 echo integration-trawl survey of the Shelikof Strait area.

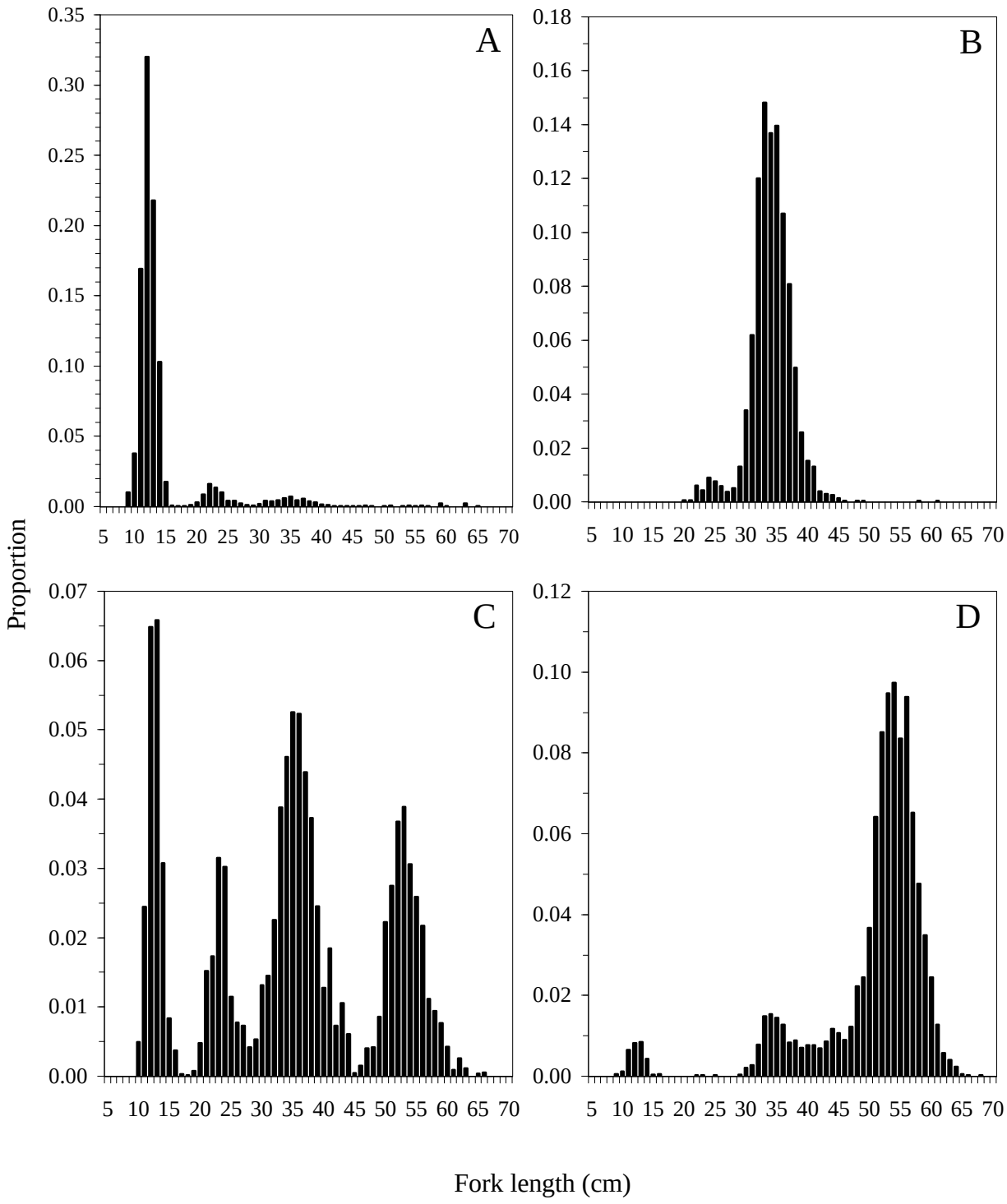

Figure 5. The size distribution of pollock (by numbers of fish) comprising (A) the age-1 layer, (B) the age-4 layer, (C) the near-bottom layer in the southern portion of the survey area, and (D) the spawning aggregation along the west side of the Strait for the 1998 echo integration-trawl survey of the Shelikof Strait area.

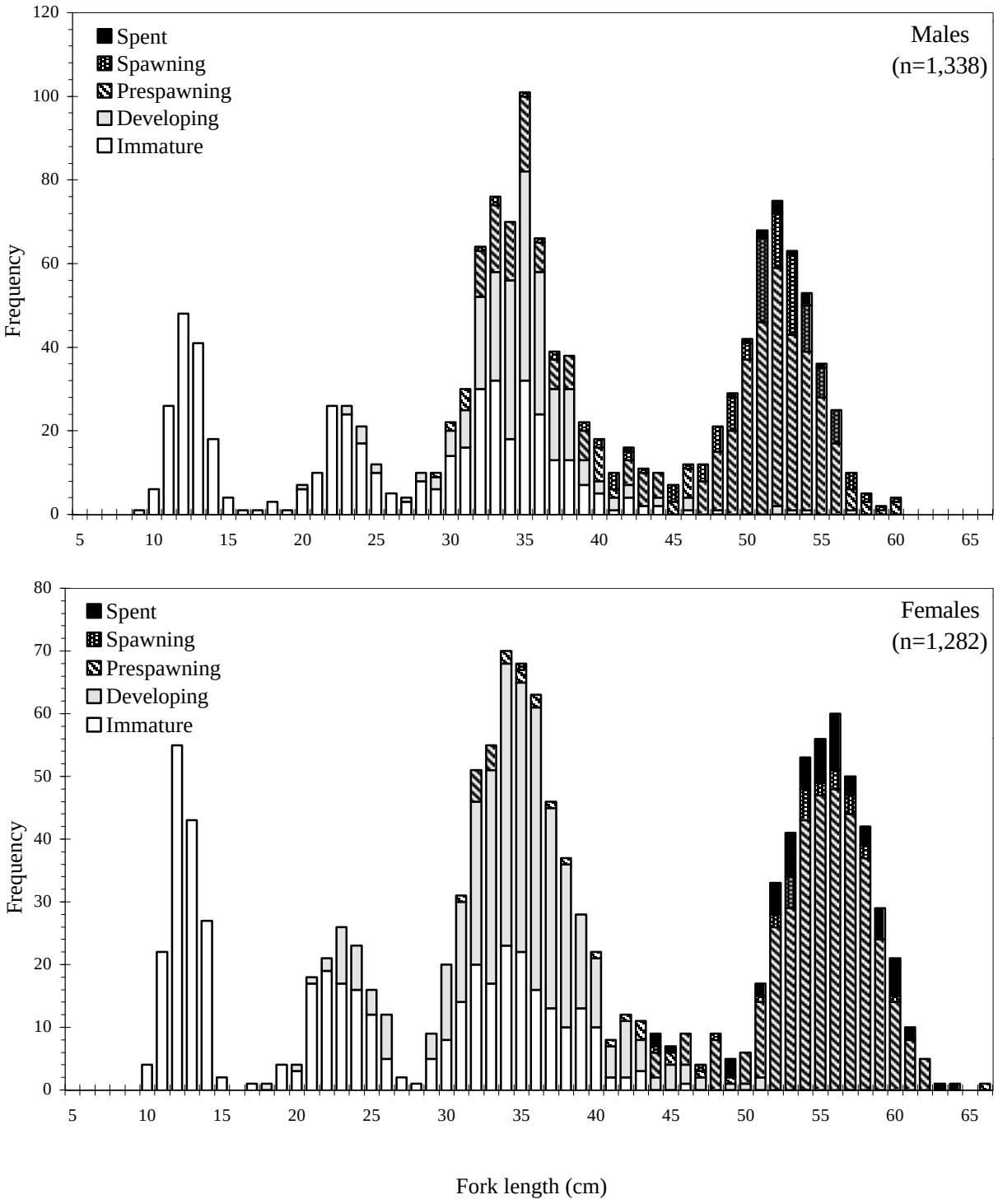

Figure 6. Maturity-length composition for male and female pollock taken during the 1998 echo integration-trawl survey of the Shelikof Strait area. Relative proportion by size for the maturity-length composition reflects the number of maturity samples collected and is not necessarily indicative of the actual size composition of the population.

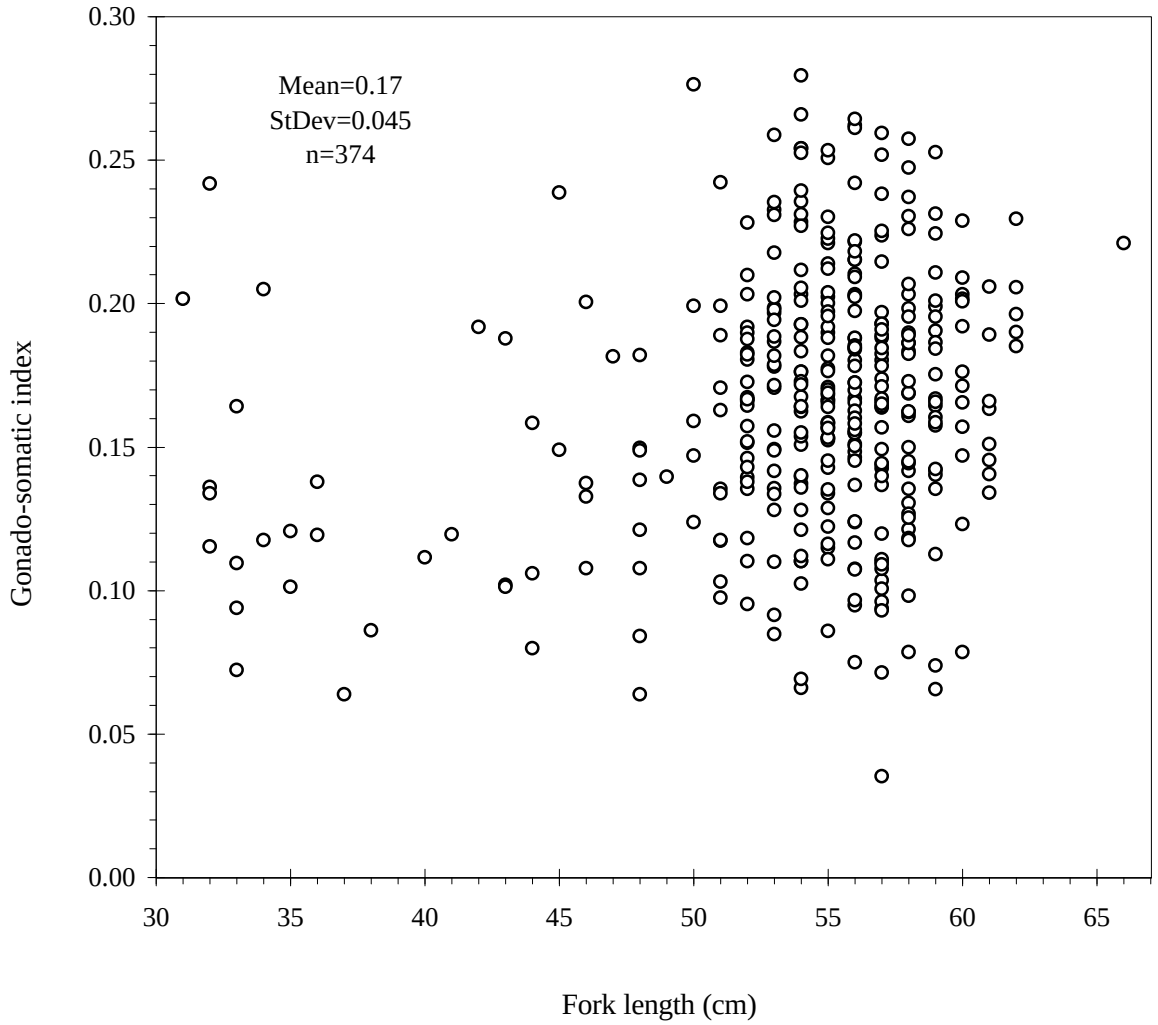

Figure 7. Pollock gonado-somatic indices plotted as a function of length for mature females caught during the 1998 echo integration-trawl survey of the Shelikof Strait area.